Wintersemester 2005-06 **English for Mechanical Engineering**
Dozent: Mark Bramwell **Klausur / 20.3.2006 / Zeit: 90 Minuten**

NAME (Großbuchstaben) [redacted].....

MATRIKELNR. .....

I READING *(14 points)*

Speed of Light

There is no better place for a "Formula 1 of solar cars" than the 3,000 kilometre Stuart Highway across the Australian desert. Every few years, flat, blue, gleaming vehicles assemble in Darwin for the "World Solar Challenge". The competition was the idea of a Danish adventurer, Hans Tholstrup, an expert in solar cars. He felt that a race would promote research and development into solar power and bring it to the attention of a broader public. And he was right. The Challenge attracted universities and big companies, like General motors with their car "Sunraycer", but also private enthusiasts like Detlev Schmitz from Munich. In 1987, the GM Sunraycer won the race and established a record at an average speed of 67 kilometres per hour.

On the 19th October 2003, 22 solar racers met for the seventh time in Darwin. This year's top favourite was the Dutch "Nuna II": 5 metres long, 1.8 metres wide and only 250 kilograms in weight. Its DC-motor is powered by 9 square metres of a new kind of gallium-arsenide solar cell used in satellites and capable of catching the sunrays on three different layers. But it's not only these solar cells that take the car up to a speed of 170 km/h. There are also powerful, lightweight Lithion Ion batteries with 5 kilowatt-hours of electrical energy, a refined power management and what is known as MPPT, maximum power point trackers. Used in satellites for years, these devices optimise the output of solar cells even in the shade. A chip measures the voltage supplied by the solar cells, compares it with the fixed battery voltage, and then determines the best voltage to charge the battery. More space technology went into the body work. The thin and extremely aerodynamic shell is reinforced by aramide in exposed areas such as mudguards. Aramide is also used to protect spacesuits against micrometeorites.

Hans Go, one of the two German entrants, was named after its main sponsor Hans Gochermann, a solar panel specialist from Hamburg. The car was developed in a joint venture between the Fachhochschule Bochum and South Bank University in London. Like Nuna II, it features gallium-arsenide solar cells, Lithion Ion batteries and a lightweight body. HansGo's top speed is "only" 125 km/h, but a race that's totally dependent on the weather is not decided by top speed alone, but also by clever power management during cloudy periods.
The other German in the race was nicknamed the suitcase man, after his collapsible car: Detlev Schmitz was back in Darwin. In order to reduce transport costs, he designed his car, the Heliodet 6, so that it could be dismantled into pieces small enough to pass as personal luggage on the plane.

Before they are admitted to the race, all solar cars have to pass a road worthiness test. This includes the usual brake, stability and safety tests, but also tests whether the car is able to pass a road train safely. These huge trucks with three or four trailers can be up to 50 metres long and are one of the main hazards on the road through the outback. The other is kangaroos,

which start roaming in the evening. This is probably one of the reasons why the driving time is limited from eight o'clock in the morning to five in the afternoon even though the sunshine hours are much longer.

October 22nd. Another perfect cloudless day and time for another record. Only slowed down by the speed limit, the Nuna II races into Adelaide. At 15:24 the race was over for the Dutch. 2997.8 km in 30 hours and 54 minutes makes an average speed of 5.21 km/h faster than the last record set by its predecessor Nuna I in 2001. Even though finishing last, Detlev Schmitz also won a prize: the "Spirit of the Event Award", gaining as much attention as the winner. Schmitz had participated in all previous World Solar Challenges. He also set a personal record: he finished the race for the first time. *(Adapted from "Engine", 3/2003)*

Circle the correct answer according to the text: A, B, C or D.
Only ONE answer is correct!

1. The World Solar Challenge was originally organised mainly in order to
   - A establish Australia as the leading country in the field of solar power.
   - B establish Denmark as the leading country in the field of solar power.
   - C promote private and public enterprise.
   - D promote solar power and make it more well-known.

2. Aramide is a substance that
   - A protects the body of solar vehicles.
   - B enables solar cells to produce power even in the shade.
   - C deflects radiation.
   - D powers Lithium Ion batteries.

3. A strength of "Nuna II" is that it
   - A is more stable than the other vehicles.
   - B is partially steered by satellite.
   - C can detect the coming of cloudy periods.
   - D uses advanced technology to increase the energy supply.

4. A German competitor
   - A could dismantle his car and make it small enough to carry onto a plane.
   - B packed his car into a suitcase and drove to Australia.
   - C designed a solar car that could generate as much power during cloudy periods as during sunny periods.
   - D designed a solar car that had already travelled between Bochum and London.

5. A reason why the driving time is limited from eight to five during the day is that
   - A it is dangerous for road trains to overtake solar cars in the dark.
   - B solar cars could collide with kangaroos.
   - C solar cars cannot brake when not supplied with sunlight.
   - D solar cars cannot be seen by road trains in the dark.

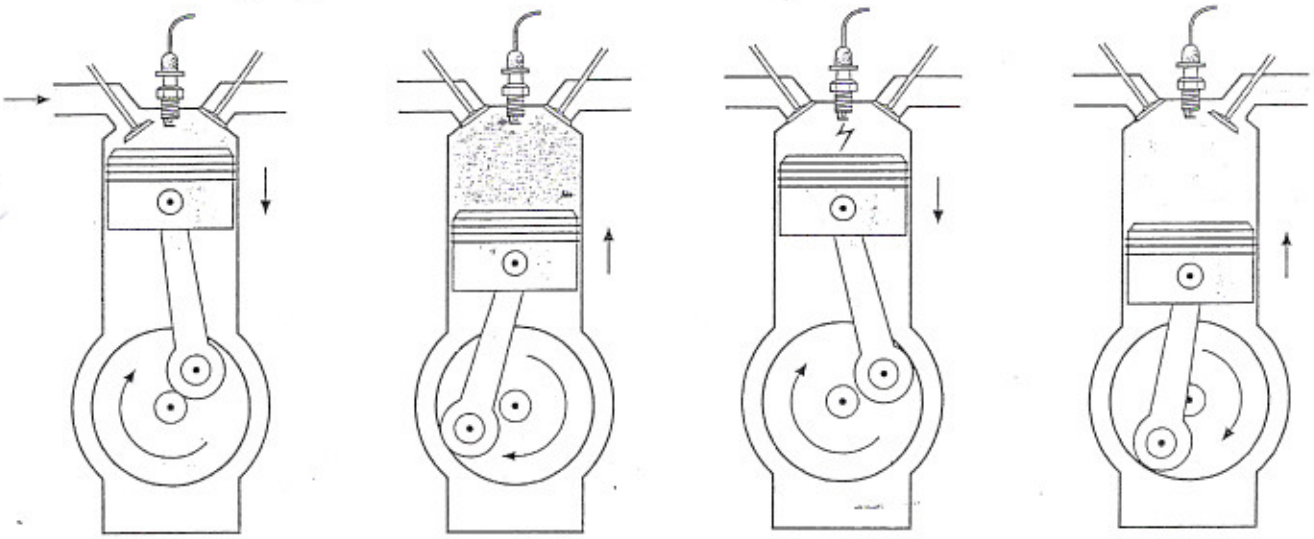
6. "Nuna II"
   - A won the race even though it was not able to reach the speed limit on Australian roads.
   - B came from Germany.
   - C set a new record in the World Solar Challenge.
   - D was the only car to win a prize.

7. Detlev Schmitz

A participated in the event for the last time.
B shared first place with "Nuna II".
C had been in every race since 1987.
D had more technical knowledge than the other competitors.

II VOCABULARY AND USE OF ENGLISH

1. Describe the function of the internal combustion engine in 70 to 100 words, based on the following diagrams: *(16 points)*



2. **Write in WORDS the following equations:** *(6 points)*

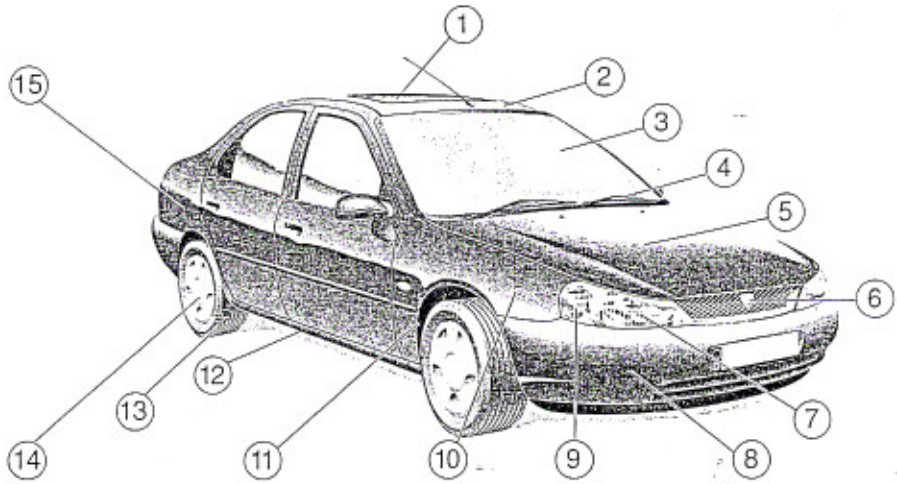
i) $\left(\frac{a+b}{c}\right)x = y$

ii) $x = 3.58$

iii) $a^5 + b^3 = \sqrt[n]{d}$

iv) $x - y = 10{,}000$

3. **Name the following parts of a typical automobile.** *(14 points)*



1_____ 2_____ 3_____

4_____ 5_____ 6_____

7_____ 8_____ 9_____

10_____ 11_____ 12_____

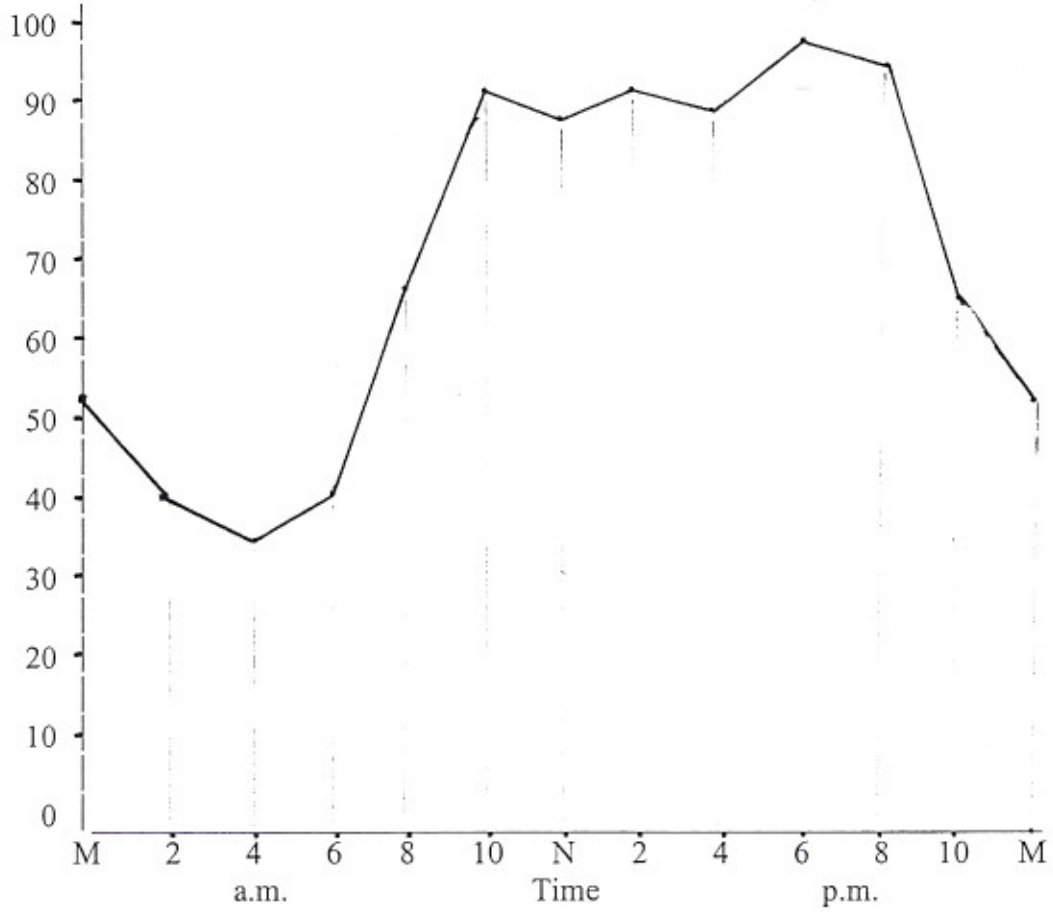
13_____ 14_____ 15_____

Study the graph below and describe the changes in load, using appropriate verbs, adverbs and adjectives Use FULL SENTENCES. Write between 70 and 100 words.

(15 points)

typical weekday load curve for a power station. The load is recorded in two-hourly steps.

(M = midnight; N = noon)



III GRAMMAR *(10 points)*

Conditionals I and II

Complete the following sentences, using the words in brackets:

1. If the safety instructions are followed, ...
   ..... (accidents / not happen)

2. If you want to study the files from the Internet, ...
   ..... (you / have to / get / a site licence)

3. If the goods were sent by sea, ...
   ..... (they / take / nearly two months)

4. If all vehicles were fitted with a catalytic converter, ...
   ..... (there / be / less / pollution)

5. If that iron rod is left in contact with air and water, ...
   ..... (it / rust)

IV WRITING *(25 points)*

Choose ONE of the following tasks and write 200 – 300 words based on the key words:

1. Write about a **solar updraft tower** using the following key words:
   the parts of a solar updraft tower and what they are made of / how the solar updraft tower works / advantages and disadvantages of the solar updraft tower compared to other methods of electricity generation / reasons why solar updraft towers are particularly suited to conditions in many developing countries / (*Optional*: brief comment on the Manzanares prototype and the plans for a 1,000 metre commercial solar updraft tower in Australia).

2. Describe the **industrial robot**. Write about the following:
   uses and advantages of robots in industry / limitations of robots / the main parts of an industrial robot / meaning of work volume and degrees of freedom / one common type of manipulator arm (rectilinear, cylindrical, spherical or anthropomorphic) / impact of robots on economy and society.

Discuss the use of **fuel cell technology to power cars**. Write about the following: advantages of fuel cells and electric engines compared to the traditional internal combustion engine / how the fuel cell works / disadvantages of the fuel cell (e.g. availability and storage of hydrogen; costs of production....) and possible future solutions.